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## The Development of a Model for Mathematics Classroom Assessment: Collaborative Assessment Pyramid

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### Abstract

In practice, Thailand has experience of learning in classroom, especially the measurement and evaluation on mathematical thinking, skills and processes. Concerning the development of system of measurement and evaluation in the past, although there were some researches which gave importance on the development of models for measuring and evaluating students' learning, those models always emphasized on the contexts that were not at fundamental academic level, or if there were some researches which did so, they frequently created the holistic pictures of the model for every subject, not specifically for mathematics which were different from other subjects. Furthermore, the model sometimes did not correlate with the standards set in the Basic Education Core Curriculum 2008. Hence, it is a challenge for Thailand to solve this problem. The learner should acquire full development in all aspects: knowledge, mathematical skills and processes, and desirable. Therefore, the objectives of the study were to: 1) develop a mathematics classroom assessment model for the demonstration schools of the Office of Higher Education Commission, and 2) investigate the quality of the model according to its utility, feasibility, propriety, and accuracy with the effects. The outcome from these three groups of people (students, teachers, and administrators). This study was an exploration research using a questionnaire that was corrected and checked by the experts. The data were collected from 120 teachers at 14 schools who were teaching at secondary level and were working under the jurisdiction of the Office of Higher Education. The model for measuring and evaluating students' learning was called a collaborative pyramid assessment, consisting of 4 dimensions of assessment: 1) collaborative plan assessment, 2) collaborative gather evidence, 3) collaborative interpret evidence, and 4) collaborative use results. There were four operational steps within each dimension: 1) knowledge, 2) thinking, 3) mathematical skills and processes, and 4) desirable attribute. The results from the implementations of this model provided ways for demonstration school teachers to do measurement and evaluation in the mathematics classroom appropriately.

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## Introduction

The development of measurement and evaluation in a classroom to create new standards for the processes of measurement and evaluation (Price, Pierson & Light, 2010) should be consistent with the educational standards and goals for the 21<sup>st</sup> century; that is to focus on fostering students' problem solving capacity, critical thinking, and higher ordered thinking which requires essential skills for them in this information technology era. Farrington & Small (2008) contended that the model of assessment of this century should focus on learning skills understanding, creation, exploration, and sharing ideas. Reeves (2008) argued that the assessment should be the assessment for learning instead of assessment of learning, thus a classroom assessment that is the most close to students is substantial. It should help improve both students' learning and teaching, particularly mathematics (Farrington & Small, 2008).

The substantial objectives of the development of mathematical knowledge and capacity are to engender students with mathematical knowledge and skills and to use them in everyday life and for study at higher level. Nooprick (2010) asserted that the reason and the necessity for learning mathematics are to help students improve their problem solving capacity and make reasoning logically; moreover, mathematics could be used as basic knowledge of any science, and it is an indicator for the success of Thailand's educational model. In general, mathematics learning and teaching in the government schools will be assessed by the Supervisor; on the contrary, the demonstration schools, under the commission of Higher Educational Office, has no model to take responsibility for this duty. As a consequence, it is the need for the demonstration schools to cooperate among teachers from each school and give their contributions to the creation of the assessment model (Marwiang, Junpeng, et al., 2012)

From the review of literature on the development of the Thai assessment model in the past, even though there were some researches that focused on the assessment of student's learning, they always emphasize on the contexts that were not at fundamental academic level, or if there were some researches done, they frequently created the holistic pictures of the model for every subject, not specifically for mathematics which were different from other subjects (Tungkasamit, 2007; Ekwarangkoon, 2007). The assessment in school mathematics classroom still uses traditional style (testing and grading), especially in every demonstration school and this model does not serve the need of the Basic Education Core Curriculum 2008. Therefore, it is a challenge for Thai educators to solve this problem. Subsequently, this study was set in order to develop the assessment model to measure and evaluate mathematics learning in a classroom setting from the demonstration schools of the Office of Higher Education Commission. Moreover, the outcome from this study can be used as guidelines for mathematics teachers to improve their teaching and also students' learning that may help increase the quality of Thai education in the future (Webb, 2004, 2009; Kaur, 2005; Rohani, 2009; Boistrup, 2011; Na nakorn, 2004; Tungkasamit, 2007; Ekwarangkoon, 2007 and Phetchara, 2010).

## Objectives

1. To create a model to measure and evaluate learning in the classroom in group learning mathematics in demonstration schools of the Office of Higher Education Commission.
2. To evaluate the quality of the measurement and evaluation of learning in the classroom in group learning mathematics demonstration schools of the Office of Higher Education Commission.

## Conceptual Framework

Clarke (2005) reported classroom assessment as emphasis of efficiency. The questions setting and suggestions were significant components of classroom assessment, and the success measure was consistent (Jan et al., 2011) about necessary knowledge and skill for activities: 1) correct data collection concerning learning achievement and

2) effective evaluation and assessment to enhance learning achievement based on Academic Affairs and Educational Standards (2008); classroom assessment had to be implemented with learning and teaching, and the result could be used as a factor to plan and design effectively based on correct, honest, accurate and completed as purposes of the Basic Education Core Curriculum (2008).

Researchers had developed a model of classroom assessment by Teachers Share Proven Instructional Methods as (Black & William, 1998; Dekker & Feijs, 2006; Otero, 2006; Webb, 2009; Boistrup, 2011 and Reeves, 2011) including 1) Collaborative Plan Assessment: CPA, 2) Collaborative Gather Evidence: CGE, 3) Collaborative Interpret Evidence: CIE and 4) Collaborative Use Results: CUR. The aims of model with effect on teachers are not only to create concept thinking and skill of mathematics classroom assessment but also to apply results to develop learner achievement (NCTM, 1995; Calfee & Masuda, 1997; Mavrommatis, 1997; Bright & Joyner, 1998; Buhagiar, 2006; Boistrup, 2011 and Reeves, 2011) as Collaborative Assessment Pyramid which emphasized new paradigm assessment to evaluate real conditions (Buhagiar, 2006) and Collaborative Action Research including 1) Mathematics content (Grow, 1996; Shafer & Foster, 1997; Black & William, 1998; Romberg, 2004; Her and Webb, 2004; Kaur, 2005; Watt, 2005; Webb, Romberg, Burrill, & Ford, 2005; Dekker & Feijs, 2006; Otero, 2006; Webb, 2009; Rohani, 2009; Boistrup, 2011); 2) thinking level (NCTM, 1995; Mavrommatis, 1997; Verhage & de Lange, 1997; Shafer & Foster, 1997); 3) Mathematical skills and process (The Institute for the Promotion of Teaching Science and Technology (IPST)) (2003), Academic Affairs and Educational Standards, (2008) and 4) desirable attribute (The Institute for the Promotion of Teaching Science and Technology (IPST)) (2003), Academic Affairs and Educational Standards, (2008)

## Methods

### *Procedure*

This research was conducted with procedure of research and development method as follows:

1. Research method: to create the mathematics assessment tools with background and requirement study and previous researches for analysis.
2. Development process: to verify assessment tools by 5 experts to consider assessment standards as Joint Committee on Standards for Educational Evaluation (1994) based on utility, feasibility, propriety and accuracy.

*The research samplers:* The mathematics lecturers at level 3 of demonstration schools of the Office of Higher Education commission in Thailand.

*Instruments:* the assessment tools were verified as utility, feasibility, propriety and accuracy issues with 5 scales for content validity of Item-Objective Congruence (IOC) to analyze consistency in terms of assessment and mathematics teaching. The IOC of assessment tools was high level and the qualification of content was high level, and, for low level questions, researchers had edited according to experts' advice.

*Data Analysis:* the content was analyzed based on research and background and requirement study of mathematics content to synthesize classroom evaluation and assessment. For verified results by experts, researchers adjusted the assessment for format development.

## Result

1. The classroom assessment for mathematics contents included 4 components: 1) Collaborative Plan Assessment: CPA, 2) Collaborative Gather Evidence: CGE, 3) Collaborative Interpret Evidence: CIE, 4) Collaborative Use Results: CUR to emphasize Collaborative Learning and team work of team teaching for 4 items as knowledge, thinking, mathematics skills and process and desirable attribute to be Collaborative Assessment Pyramid for real assessment concept driving and also collaborative action research.

2. From the results of classroom assessment tools for mathematics content of demonstration schools of the Office of Higher Education Commission, we found that the development model was utility, feasibility, propriety and accuracy at high level based on research and requirement on development of real classroom assessment.

## Discussions and Conclusion

The results declared that the developed model benefited classroom assessment and also practical feasibility, the correct and proper content for the demonstration schools of the Office of Higher Education Commission of Thailand based on requirement study (Suwimol, 2011) in real classroom assessment development. The necessity of collaborative team teaching, the various learning assessment concepts and thinking (Marwiang, Junpeng et al., 2012) showed that the components of the model could reach the goal as concept of Kaur (2005), Webb (2009), Rohani (2009), Boistrup (2011), Reeves (2011), Panhoon (2005), Tungkasamit (2007) and Nooprick (2010) which reported that classroom assessment should be part of learning. For the usage of results of learning evaluation, it supported collaborative team teaching to organize effective mathematics learning.

According to the development of classroom assessment for mathematics content, we found that Collaborative Action Research could be used as main important part of model to implement practically because concerned people were emphasized as completed team teaching as concept of Webb (2009), and Boistrup (2011); the assessment which reflected the opinion of classroom assessment design to show how collaborative team teaching of various expert teachers could enhance wider research area. The collaborative action research stimulated the improved classroom assessment process with pedagogy.

Nevertheless, this procedure was just the evaluation results of experts to verify assessment tools. For the next step of research, the improved tools would be tried out as the experts' advice about components. Moreover, the evaluation was not only effective on learners and teachers, but also on cooperative teachers in terms of knowledge development and network expansion. Finally, the feedback of model could be adjusted as different factors so that it would be flexible to institution context.

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